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(56) Documents cited  
GB 2234593 A GB 1524753 A WO 86/03637 A  
US 4310767 A

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(54) Refrigeration monitoring systems

(57) A monitoring system for a refrigerated container 13 of an articulated vehicle has a transmitter section for mounting in the semi-trailer and a receiver section for mounting on the tractor unit 10. The transmitter section has a sensor 16 for temperature within the container, and also sensors for various operating conditions for a diesel engine driven refrigeration plant 14 mounted on the container 13. The transmitter section encrypts the output from the sensors and has an infra-red transmitter 18 directed generally forwardly for transmitting the encrypted signal. The receiver section has an infra-red receiver 23 to receive that signal; the signal is decoded and the relevant data is displayed on a display unit 25. A radio transceiver may be incorporated within the transmitter section to permit remote interrogation of the transmitter section regarding the parameters monitored thereby.

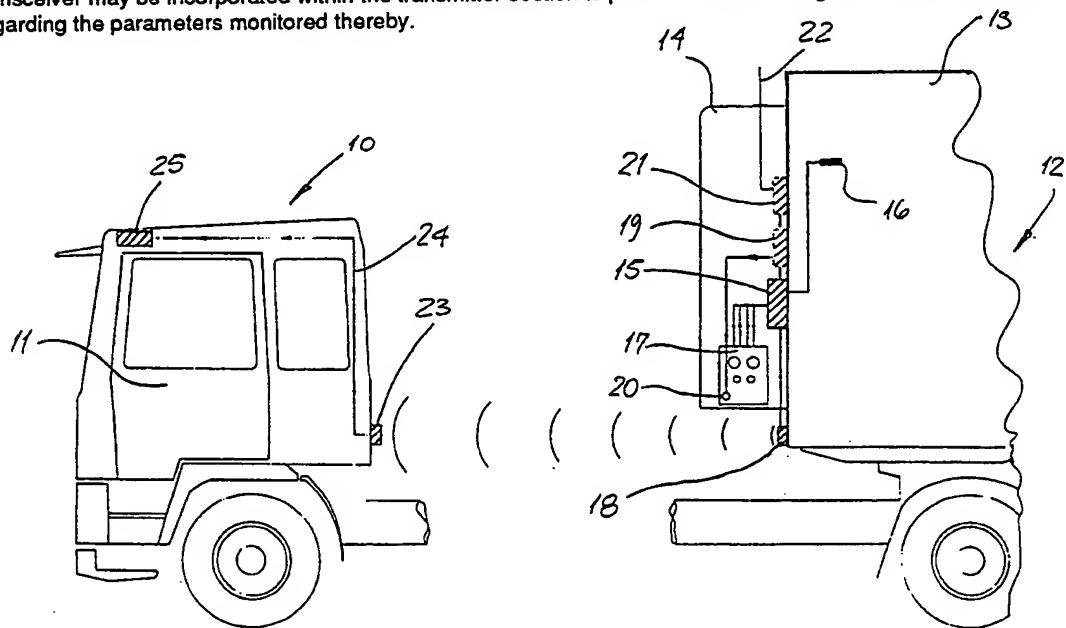


FIG. 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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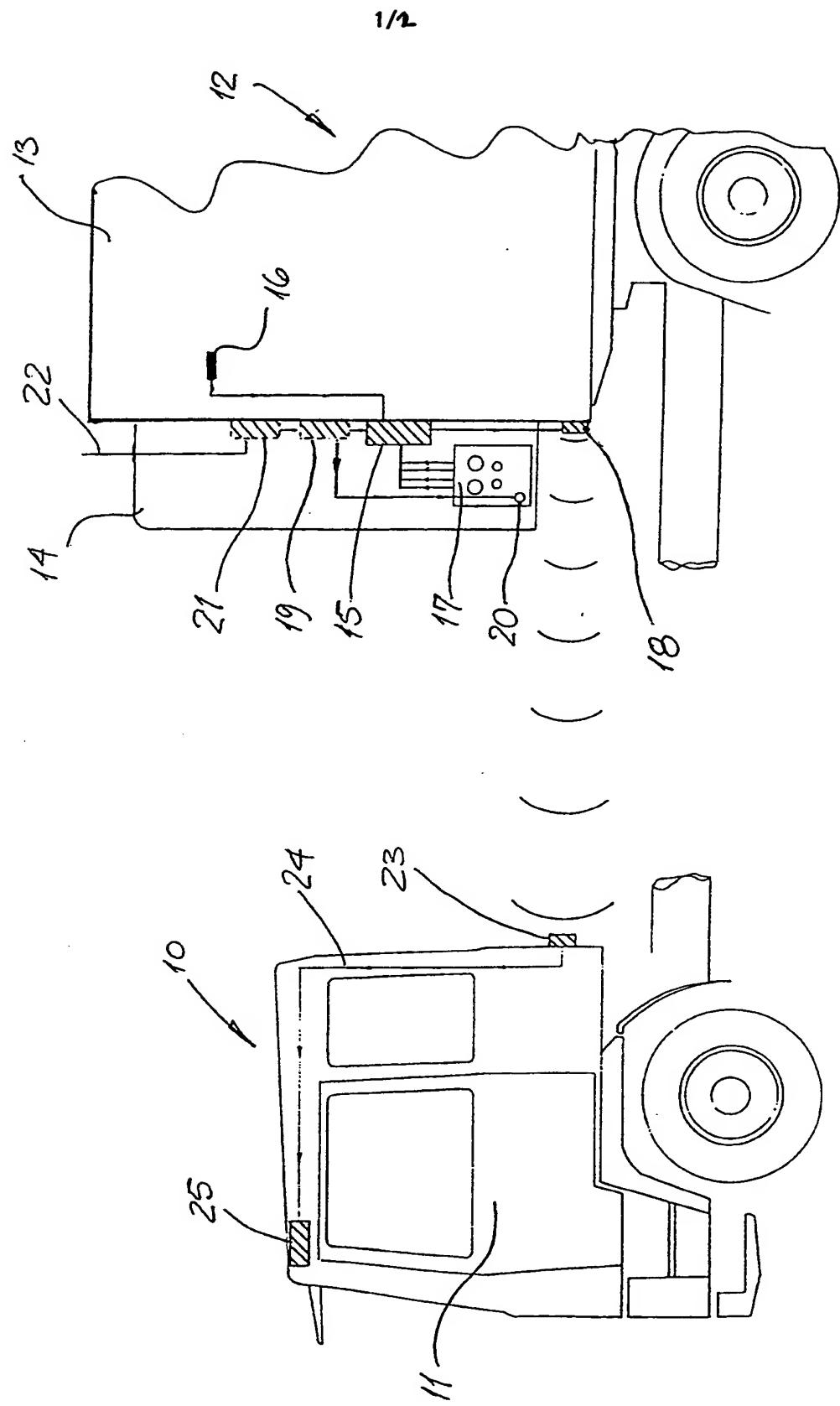
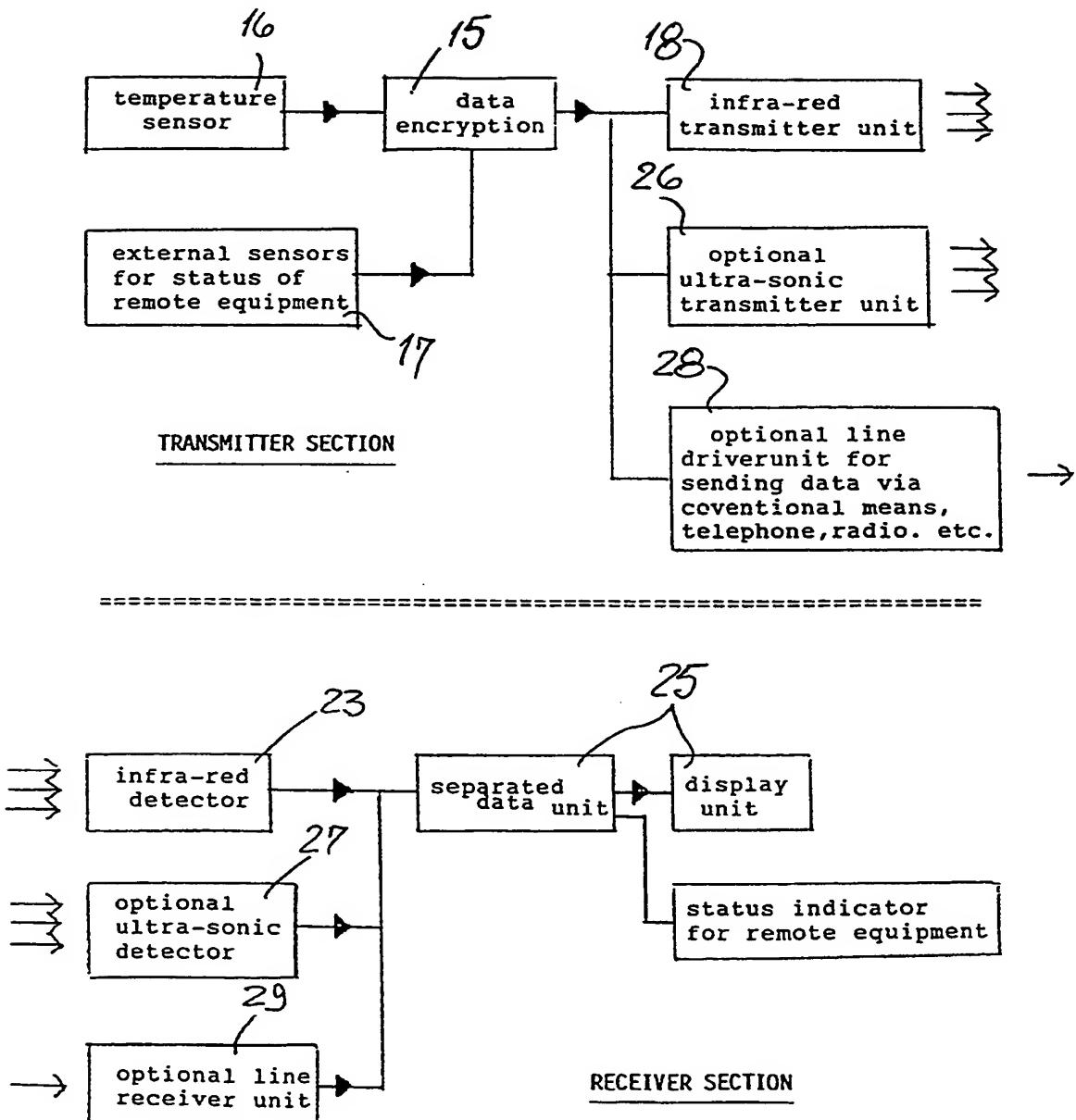


FIG. 1

FIG. 2



## REFRIGERATION MONITORING SYSTEMS

This invention relates to a monitoring system for a refrigerated container, and in particular - but not exclusively - for such a container in the form of a semi-trailer arranged to be towed by a tractor unit.

5 Many food-stuffs have to be transported in refrigerated containers, in order that the food-stuffs may be protected from deterioration. It is important that the temperature within the container is maintained between relatively closely-defined limits, and various  
10 control systems have been designed for this purpose. It is however important that a driver of a vehicle having a refrigerated container for food-stuffs is made aware of any deviation of the temperature within the container outside the pre-defined limits, so that  
15 immediate remedial action may be taken.

It is known to fit a temperature sensor within a refrigerated container, and to connect that sensor by means of a flexible cable to a control unit fitted within the driver's cab, the unit having a display to  
20 inform the driver of the actual temperature within the refrigerated container. The control unit may also have an alarm system with pre-settable temperature limits, in order that an alarm may be given should the temperature within the container move outside those  
25 pre-set limits.

Though a temperature monitoring system as described above may operate satisfactorily for a rigid vehicle, it has been found to be less than wholly reliable when fitted to an articulated vehicle, or to a 5 trailer towed by a rigid vehicle. The relative movement between the tractor unit and the semi-trailer having the refrigerated container (or rigid vehicle and its trailer) subjects the sensor connecting cable to constant flexing, which can lead to unreliability 10 either by the conductors within the cable fracturing, or by a failure at the termination of the cable. Moreover, it is necessary to provide a separable plug-and-socket connector in the cable or at one of its ends and which is easily accessible to allow the semi- 15 trailer to be disconnected from the tractor unit. When disconnected, such a connector is likely to be subjected to the elements resulting in corrosion of the connecting pins, and so a variable contact resistance. In view of the relatively low-level signals produced by 20 the temperature sensor and the variable contact resistance within such a connector, reliability and accuracy can be adversely affected.

It is a principal aim of the present invention to provide a monitoring system for at least the 25 temperature within a refrigerated container which system - when applied to an articulated vehicle or rigid vehicle and trailer - minimises the difficulties

discussed above, for the known kind of monitoring system.

According to the present invention, there is provided a monitoring system for a refrigerated 5 container, which system comprises:

10 a transmitter section adapted for mounting on the container and having a sensor to monitor at least the temperature within the container, a control circuit to encrypt the temperature sensor output and to produce corresponding data signals, and an infra-red transmitter arranged to transmit 15 said data signals; and

15 a receiver section adapted for mounting remotely from but in sight of the transmitter section, the receiver section having an infra-red receiver adapted to receive the transmitted infra-red data signal from the transmitter section, means to separate temperature data from the received signals, and a display device to display 20 said temperature data.

Though the monitoring system of this invention could be used in different circumstances, it is primarily intended for use in connection with an articulated vehicle having a refrigerated container 25 semi-trailer or in connection with a rigid vehicle towing a trailer. The invention will hereinafter be explained in greater detail principally referring to

its use on an articulated vehicle, though it is to be understood that the invention is not limited in that use.

In the case of an articulated vehicle having a  
5 refrigerated semi-trailer, the transmitter section  
should be mounted on the container with the infra-red  
transmitter thereof being directed forwardly towards  
the tractor unit, when the semi-trailer is coupled  
thereto. The infra-red receiver of the receiver  
10 section should be mounted behind the cab of the tractor  
unit so as to look at the infra-red transmitter of the  
transmitter section, whereby the infra-red receiver may  
receive the signal transmitted by the infra-red  
transmitter. In this way, the problems discussed above  
15 of having a flexible cable and separable connector  
between the refrigerated container and the tractor  
unit, which cable carries relatively low-level signals,  
are eliminated.

The display device of the receiver section is  
20 preferably mounted within a casing separate from that  
of the infra-red receiver, whereby the display device  
may be positioned at some location where the driver of  
the tractor unit may readily see the temperature within  
a towed refrigerated container. The means to separate  
25 the temperature data from the received signals may be  
disposed within the casing of the display device, or  
within a casing which houses the infra-red receiver, or

even within some other casing disposed at some suitable point. Alternatively, the components of the receiver section may be mounted within a single casing which could be positioned, for example, within a rearwardly 5 facing window of the tractor unit, with the display device facing forwardly.

In the case of an articulated vehicle having a refrigerated container semi-trailer, the refrigeration plant often takes the form of a diesel engine-driven 10 self-contained unit, whereby refrigeration of the container may be continued irrespective of whether the semi-trailer is coupled to a tractor unit. The monitoring system of the present invention may be modified also to monitor certain operating parameters 15 of the self-contained refrigeration plant, such as engine operation, low oil pressure, engine coolant, overheating and the output of an engine-driven electrical alternator. The monitoring system may further be arranged to monitor the electrical systems 20 supplied with power from the diesel engine alternator, such as the operation of container heating elements which may be provided within the container. Appropriate sensors are provided for each of the parameters to be monitored, the sensors being coupled 25 to the control circuit of the transmitter section, whereby data signals including data about the monitored parameters may be produced, for transmission to the

receiver section.

For the arrangement described above, the receiver section should be configured so as to be able to detect fault conditions for any of the monitored parameters 5 and to issue a suitable warning - either visual, audible, or both - to a driver of the vehicle.

The transmitter section may further be modified to include a radio transceiver, to permit remote interrogation of the various monitored parameters, 10 including the temperature within the container. Such remote interrogation may be performed by means of a cellular telephone network, the transceiver of the transmitter unit in effect being a mobile terminal adapted to receive and transmit digital data by using a 15 modem, upon interrogation by a suitable static system also coupled to the cellular telephone network. In this way, the owner of any food-stuffs within a refrigerated container, or his agent, may remotely check on at least the temperature within the container 20 at random times, without the driver of the vehicle being made aware of this.

Though the monitoring system of this invention is primarily intended to use the infra-red link between the transmitter section and the receiver section, 25 nevertheless for the transmitter section and the receiver section could be provided with appropriate connectors to allow those units to be linked by an

electrical cable, in order to permit easy installation of the system for example on a rigid vehicle having a refrigerated container, or on some static installation. Also, a further option would be the use of an 5 ultrasonic link, for certain applications of the monitoring system.

By way of example only, one specific embodiment of a monitoring system arranged in accordance with the present invention will now be described in detail, 10 reference being made to the accompanying drawings, in which:-

Figure 1 is a diagrammatic sketch of the embodiment of monitoring system installed in an articulated vehicle having a refrigerated container semi-trailer; and 15 Figure 2 is a block diagram of the transmitter and receiver sections of the monitoring system.

Referring initially to Figure 1, the articulated vehicle comprises a tractor unit 10 having a driving cab 11, and a semi-trailer 12 including a refrigerated 20 container 13. Mounted on the front of the container 13 is a self-contained, diesel engine driven refrigeration plant 14, the diesel engine (not shown) also driving an alternator (also not shown) to supply electricity for automatic operation of the refrigeration plant, battery 25 charging, and so on.

The monitoring system includes a transmitter section mounted on the container 13, and a receiver

section mounted on the tractor unit 10. The transmitter section includes a data encryption unit 15 which receives the output from a temperature sensor 16 mounted within the container 13, and also the outputs 5 from a number of separate sensors (not shown) associated with the diesel engine driven refrigeration plant 14, as shown diagrammatically at 17.

Mounted on the front of the container 13 is an infra-red transmitter 18, arranged to direct infra-red 10 radiation forwardly, towards the cab 11 of the tractor unit 10. The infra-red transmitter 18 receives encrypted data signals from the data encryption unit 15, and transmits forwardly an infra-red beam carrying 15 encoded information concerning the various sensed parameters, including the temperature within the container 13.

The transmitter section may include a down-load interface unit 19, shown in broken lines, which may store information produced by the data encryption unit 20 for subsequent down-loading to an external computer system through a port 20. The transmitter section may further include an optional radio communications transceiver unit for example adapted to operate through the cellular telephone network, the transceiver being 25 provided with a radio transmitting and receiving aerial 22. Again, the radio communication transceiver receives signals from the data encryption unit 15

indicative of the monitored parameters including the temperature within the container 13, whereby on being interrogated from a remote point, that transceiver may transmit to the remote point the required information.

5       The receiver section of the monitoring system has an infra-red detector 23 housed in a casing mounted on the rear of the cab 11, such that the detector may receive radiation from the infra-red transmitter 18. The detector is coupled by cable 24 to a display unit  
10 25 which houses the required control circuit to drive a display device (not shown) with the appropriate information indicative of the sensed parameters within the container 13. The display unit advantageously is mounted within the cab 11, where it may readily be  
15 viewed by a driver of the tractor unit 10. The display device thus may have a two-and-one-half digit seven-segment display for indicating temperature within the container 13, and also suitable warning lights and an audible alarm for the monitored parameters of the  
20 diesel engine driven refrigeration plant, such as engine coolant overheating, low oil pressure, and so on.

Figure 2 is a block diagram of the transmitter section and the receiver section of the monitoring system described above. In this Figure, like parts with those described above are given like reference characters and will not be described again here. Also

shown in Figure 2 is the provision of an optional ultra-sonic transmitter unit 26, which may be used for certain installations either in parallel with or instead of the infra-red transmitter 18. The receiver 5 section also is shown as including an optional ultra-sonic detector 27 co-operable with the ultra-sonic transmitter 26.

Figure 2 further shows an optional driver unit 28, arranged to supply a signal from the data encryption 10 unit 15, as may be required. This unit 28 may be used to connect a wire link directly between the transmitter and receiver sections, or may be used to drive a modem or a radio frequency transceiver, and so on. Similarly, the receiver section is provided with an 15 optional line receiver unit 29, to permit the connection of a wire link to the receiver section.

**CLAIMS**

1. A monitoring system for a refrigerated container, which system comprises:

5                   a transmitter section adapted for mounting on the container and having a sensor to monitor at least the temperature within the container, a control circuit to encrypt the temperature sensor output and to produce corresponding data signals, and an infra-red transmitter arranged to transmit said data signals; and

10                  a receiver section adapted for mounting remotely from but in sight of the transmitter section, the receiver section having an infra-red receiver adapted to receive the transmitted infra-red data signal from the transmitter section, 15 means to separate temperature data from the received signals, and a display device to display said temperature data.

2. A monitoring system according to claim 1, wherein the display device of the receiver section is mounted 20 within a casing separate from a casing for the infra-red receiver but coupled thereto by a cable, whereby the display device may be positioned at some location remote from the location of the casing for the infra-red receiver.

25           3. A monitoring system according to claim 1, wherein

the components of the receiver section are mounted within a single casing, with the infra-red receiver and the display device facing in opposite directions.

4. A monitoring system according to any of the 5 preceding claims, wherein the transmitter section is adapted for mounting on the semi-trailer of an articulated vehicle with the infra-red transmitter of the transmitter section facing generally forwardly, and the receiver section is adapted for mounting on the 10 tractor unit of an articulated vehicle with the infra-red receiver facing generally rearwardly to receive signals from the transmitter of the transmitter section.

5. A monitoring system according to claim 4, and in 15 which the semi-trailer with which the transmitter section is adapted to be used includes a self-contained diesel engine-driven refrigeration plant, wherein the monitoring system is arranged also to monitor one or more operating parameters of the self-contained 20 refrigeration plant.

6. A monitoring system according to claim 5, wherein the monitored parameters of the refrigeration plant comprise one or more of engine operation, low oil pressure, engine coolant, overheating and the output of 25 an engine-driven electrical alternator.

7. A monitoring system according to claim 5 or claim 6, wherein the transmitter section is arranged to

monitor one or more electrical systems associated with the refrigerated container.

8. A monitoring system according to any of claims 5 to 7, wherein the receiver section is configured to 5 detect a fault condition for any one of the parameters monitored by the transmitter section and to issue a warning on detection of such a condition.
9. A monitoring system according to any of the preceding claims, wherein the transmitter section is 10 associated with a radio transceiver, to permit remote interrogation of at least one parameter monitored by the system.
10. A monitoring system according to any of the preceding claims, wherein both the transmitter section 15 and the receiver section are provided with connector parts permitting the linking together of the two sections by an electrical cable having at its ends the corresponding connector parts.
11. A monitoring system substantially as hereinbefore 20 described with reference to and as illustrated in the accompanying drawings.
12. An articulated vehicle having a refrigerated container semi-trailer and whenever the semi-trailer has been fitted with the transmitter section to permit 25 the monitoring of at least the temperature within the container, and the tractor unit of the vehicle has been fitted with the receiver section to receive data signals transmitted by the transmitter system.

Patents Act 1977  
Examiner's report to the Comptroller under  
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Relevant Technical fields

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H4B : BK10; BK22  
(ii) Int CL (Edition 5 ) G08C ; H04B

Search Examiner

ALAN STRAYTON

Databases (see over)

(i) UK Patent Office  
(ii) ONLINE DATABASE: WPI

Date of Search

24 JUNE 1992

Documents considered relevant following a search in respect of claims

1-11

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2234593 A Page 3, lines 13-26	1,2,3,4,5 8,10
Y	GB 1524753 Page 3, lines 24-45	1-4,5,8, 10
Y	WO 86/03637 Page 2, line 10 - page 3, line 4	1-4,5,8, 10
Y	US 4310767 Column 2, line 25 - column 3, line 53	1-4,5,8, 10

Category	Identity of document and relevant passages	Relevant to claim(s)

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